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Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary	Application No. 09/296,835	Applicant(s) Weimer et al.
	Examiner Erik Kielin	Group Art Unit 2813

☒ Responsive to communication(s) filed on *Mar 21, 2001* .

☒ This action is **FINAL.**

☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

A shortened statutory period for response to this action is set to expire *3* month(s), or thirty days, whichever is longer, from the mailing date of this communication. Failure to respond within the period for response will cause the application to become abandoned. (35 U.S.C. § 133). Extensions of time may be obtained under the provisions of 37 CFR 1.136(a).

Disposition of Claims

☒ Claim(s) *1-6 and 8-12* is/are pending in the application.

Of the above, claim(s) _____ is/are withdrawn from consideration.

☐ Claim(s) _____ is/are allowed.

☒ Claim(s) *1-6 and 8-12* is/are rejected.

☐ Claim(s) _____ is/are objected to.

☐ Claims _____ are subject to restriction or election requirement.

Application Papers

☐ See the attached Notice of Draftsperson's Patent Drawing Review, PTO-948.

☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

☐ The proposed drawing correction, filed on _____ is ☐approved ☐disapproved.

☐ The specification is objected to by the Examiner.

☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

☐ All ☐ Some* ☐ None of the CERTIFIED copies of the priority documents have been

☐ received.

☐ received in Application No. (Series Code/Serial Number) _____ .

☐ received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

*Certified copies not received: _____ .

☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

☐ Notice of References Cited, PTO-892

☐ Information Disclosure Statement(s), PTO-1449, Paper No(s). _____

☐ Interview Summary, PTO-413

☐ Notice of Draftsperson's Patent Drawing Review, PTO-948

☐ Notice of Informal Patent Application, PTO-152

--- SEE OFFICE ACTION ON THE FOLLOWING PAGES ---

DETAILED ACTION

Claim Rejections - 35 USC § 112

1. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

2. Claims 1-6, 8-12 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention.

Applicant only indicates that the oxidizing species does not "significantly" diffuse through the dielectric film (page 3, lines 22-25; page 4, lines 13-18; and page 10, last sentence) which indicates that there is necessarily some diffusion of oxidizing species through the dielectric film. Neither the specification not any evidence of record indicates that there is absolutely no diffusion through the dielectric film as presently claimed.

3. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

4. Claims 1-6, 8-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

5. Claim 1 recites the limitation "an underlying layer" in the last line. There is insufficient antecedent basis for this limitation in the claim.

6. Claims 1-12 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential steps, such omission amounting to a gap between the steps. See MPEP § 2172.01. The omitted steps are: depositing or providing the underlying layer. There is no mention upon what the dielectric film is deposited. The claim simply recites "depositing an oxygen-deficient dielectric film" therefore, it is unclear as to what "diffuse through the dielectric film into a layer underlying the dielectric film" means because no "layer underlying the dielectric film" has been deposited or otherwise provided. Claims 2-12 are considered indefinite for having all of the limitations of claim 1.

For the remainder of the action, claim 1 will be interpreted as best understood by Examiner.

Claim Rejections - 35 USC § 102

7. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

(e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

8. Claims 1, 7-8 are rejected under 35 U.S.C. 102(b) as being anticipated by **Emesh** et al. (US 5,728,603).

Emesh discloses forming an oxygen deficient dielectric; subjecting the dielectric film to a wet oxidation in a rapid thermal process (RTP) chamber at a temperature less than 500 C (Abstract); which inherently increases the oxygen content of the film as indicated by reduced leakage current (sentence bridging columns 3-4). *See* In re Swinhart, 169 USPQ 226,229 (CCPA 1971) (where the Patent Office has reason to believe that a functional limitation asserted to be critical for establishing novelty in the claimed subject matter may, in fact, be an inherent characteristic of the prior art, it possesses the authority to require the applicant to prove that subject matter shown to be in the prior art does not possess the characteristics relied on) and In re Fitzgerald, 205 USPQ 594 (CCPA 1980) (the burden of proof can be shifted to the applicant to show that subject matter of the prior art does not possess the characteristic relied on whether the rejection is based on inherency under 35 USC 102 or obviousness under 35 USC 103). In the instant case, note that **Applicant's specification** on page 3, lines 18-20 **indicates** that the **wet oxidation provides "a film that is less prone to leakage."** Therefore, Applicant's specification affirms the inherency of the Emesh invention.

Regarding claim 7, because the underlying layer is Pt which has been pretreated to form an adhesive oxide layer prior to deposition of the dielectric film (column 6, lines 22-27) the oxygen inherently does not "significantly" diffuse through the dielectric film, as it cannot diffuse into passivated Pt. See In re Swinhart and In re Fitzgerald, *supra*.

Regarding claim 8, see column 8, Table I.

9. Claims 1-6, 9, 12 are rejected under 35 U.S.C. 102(e) as being anticipated by **Miner** et al. (US 6,114,258).

Miner discloses forming an oxygen deficient dielectric 110 (Figs. 1-3; column 4, lines 21-65); subjecting the dielectric film to a wet oxidation in a rapid thermal process (RTP) chamber (column 5, lines 39-51; Fig. 4) at a temperature range of 400 to 1250 C (column 8, lines 13-32); and post treating the reoxidized dielectric in N_2 withing the RTP chamber (column 10, line 64 to column 11, line 15); wherein the wet oxidation is carried out within the RTP chamber by heating hydrogen and oxygen gases in various ratios to form a mixture of steam and non-steam in various ratios (column 8, line 57 to column 9, line 45) for various times (column 10, lines 18-43; Fig. 13). Both ratios and times clearly anticipate those in the instantly claimed invention.

Regarding claim 7, see Fig. 9b which shows that oxygen "does not diffuse significantly through the dielectric film into the underlying layer." In other words, the oxygen does not cross the interface (right-hand axis) as determined by SIMS.

Claim Rejections - 35 USC § 103

10. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

11. Claims 2-3 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Emesh** et al.

The prior art of **Emesh** as explained above discloses all of the limitations of claims 1-2, 8 but does not disclose Applicant's exact temperature ranges. An objective in **Emesh** is keep the temperature below 500 C during fabrication to keep the thermal budget low which is highly desired in the art (Abstract). **Emesh** also discloses that standard art temperatures that anticipate those instantly claimed (columns 1-3).

These claims are *prima facie* obvious without showing that the claimed ranges achieve unexpected results relative to the prior art range. *In re Woodruff*, 16 USPQ2d 1935, 1937 (Fed. Cir. 1990). See also *In re Huang*, 40 USPQ2d 1685, 1688(Fed. Cir. 1996)(claimed ranges of a result effective variable, which do not overlap the prior art ranges, are unpatentable unless they produce a new and unexpected result which is different in kind and not merely in degree from the results of the prior art). See also *In re Aller*, 105 USPQ 233 (CCPA 1955) (selection of optimum ranges within prior art general conditions is obvious).

It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Applicant's claimed temperature range because Emesh indicates that this range is standard in the art and because Emesh teaches that increasing the temperature at which the wet oxidation occurs increases the dielectric constant of the high dielectric constant film (column 8, lines 6-12) which is desired in the semiconductor device fabrication art.

12. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over **Emesh** et al. in view of **Wolf** (Silicon Processing for the VLSI Era, Vol. 1).

Regarding claim 4, the prior art of **Emesh** as explained above discloses all of the limitations of claims 1-2, 7-8 but does not disclose duration of the RTP, wet oxidation.

Wolf teaches that rapid thermal processes are carried out for a period of time of seconds to a few minutes (page 57). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use 20-60 seconds because these are typical times for rapid thermal processes and because it has been help that routine optimization with a limited number of variables is *prima facie* obvious. *In re Jones*, 162 USPQ 224 (CCPA 1955)(the selection of optimum ranges within prior art general conditions is obvious).

13. Claims 1, 3, 4, 7, 9-10, 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Jeng** (US 5,661,072).

Jeng discloses a method of fabricating a semiconductor device comprising, depositing an oxygen deficient dielectric film; performing a stabilizing treatment in O_2 and trans-LC; wet

oxidizing the dielectric which inherently increases the oxygen content of the oxygen-deficient dielectric film; and then dry oxidizing (column 3, lines 55-60).

Although Jeng does not indicate that the process occurs in a rapid thermal process (RTP) chamber, this is not given patentable weight because it has been held that to be entitled to weight in method claims, the recited structure limitations therein must affect the method in a manipulative sense, and not amount to the mere claiming of a use of a particular structure. *Ex parte Pfeiffer*, 1962, C.D. 408 (1961). In the instant case, performing the process in and RTP chamber is not manipulative of the method and therefore does not have patentable weight.

14. Claims 1-2, 5-7, 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over **Takemura** (US 5,534,716).

Takemura discloses a method of fabricating a semiconductor device comprising, depositing an oxygen deficient dielectric film 303 (Figs. 7A-7f); performing a stabilizing treatment in N_2 at 500 to 620 C (column 10, lines 40-42); wet oxidizing the dielectric film at 550 to 650 C (column 10, lines 53-65) which increases the oxygen content of the oxygen-deficient dielectric film; and annealing in nitrous oxide (N_2O) at 600 C. Note that a pyrogenic method is used to form the steam and the ratios of hydrogen to oxygen and steam to total gases anticipates those ranges of the instant invention.

Regarding claim 11, note that the temperature of the wet oxidation may be higher than that used during the stabilizing anneal.

Only the rapid thermal process chamber is not taught, but does not have patentable weight, as noted above, according to the precedent in *Ex parte Pfeiffer*.

Response to Arguments

15. Applicant's arguments filed 3/21/01 have been fully considered but they are not persuasive.

16. Applicant's arguments regarding the rejection of claims 1, 7-8 under 35 U.S.C. 102(b) are *wholly without merit*. Applicant argues that "Emesh does not teach or suggest 'a wet oxidation in a rapid thermal process chamber at a temperature of at least about 450 C and for a duration which increases the oxygen content of the dielectric film but does not allow an oxidizing species to diffuse through the dielectric film into a layer underlying the dielectric film.' " Examiner respectfully, but specifically disagrees. All of the features are disclosed as indicated above.

Applicant further argues that "Emesh does not teach oxidation of a dielectric material having a dielectric constant of at least about 25.' " **As pointed out in the previous office action** and above, Emesh clearly discloses dielectric constants of well over 25 in Table I of column 8.

Applicant argues that the oxygen content isn't increased, but it is necessarily increase as this is the manner by which the leakage current in both Emesh and in the instant invention is reduced, as indicated by Applicant. Furthermore, the above case law makes clear that it is Applicant's responsibility to provide evidence that Emesh does not increase the oxygen content and none has been provided. To the contrary, given the evidence in Applicant's specification, as

noted above, the Emesh dielectric film must show an increase in oxygen content otherwise the leakage current would not be reduced.

Applicant further argues that Emesh is silent about diffusion into an underlying layer, but as indicated above and in the previous office action, no diffusion can occur into passivated platinum or into the platinum itself. First, platinum could not be a noble metal if it allowed oxygen diffusion into it; otherwise, it would corrode just like iron (oxidized iron is rust occurring from the diffusion of oxygen into iron and reaction therewith). Platinum does not do this, i.e. allow the oxygen to diffuse beyond surface passivation; otherwise it would necessarily corrode. Second, the first point is emphasized by the fact the Emesh is forming a functioning capacitor, like Applicant is which requires a conductive electrode for operability. Platinum is the Emesh electrode and is the "underlying layer" of the dielectric film. Oxidized metals, i.e. metal oxides, are not generally conductive, platinum oxide is specifically **not** conductive. Therefore, oxygen could not have diffused into the Pt because the device would be rendered inoperable. And as above, in inherency arguments, the Applicant has the burden of proof to demonstrate that there is somehow diffusion through the Emesh dielectric film into the underlying Pt film. Given that the processes are the same in both Emesh and in the instant invention, evidence is essential in demonstrating that Emesh has not disclosed Applicant's claimed feature of no significant diffusion of oxidizing species. None has been provided.

Further in this regard, given that Emesh appears to prefer the lower end of Applicant's claimed temperature range and that it is well known to those of skill in the art that diffusion rate

of any species **increases** as the temperature increases. There is further evidence that there exists no diffusion through the Emesh film because the temperature is at Applicant's lower range. Therefore, it is improper for Applicant to posit the Emesh has diffusion without providing evidence for such diffusion when Applicant's invention appears more likely to cause diffusion by virtue of the higher temperatures preferred during the oxidation.

17. Applicants arguments regarding **Miner**, **Jeng,** and **Takemura** are not persuasive. First, each of **Miner**, **Jeng,** and **Takemura** is drawn to forming oxygen deficient dielectric layers whose oxygen content by is increased by a wet oxidation with resulting improvement in the electrical/physical properties, regardless of the other information disclosed therein. In short, as presently claimed, Applicant's invention is indistinguishable from any of **Miner**, **Jeng,** and **Takemura**.

Applicant appears to argue that the Miner silicon nitride and silicon oxynitride is not a dielectric layer. Those of skill in the art know very well that both silicon nitride and silicon oxynitride are dielectric materials and are used for such dielectric properties in the semiconductor device fabrication art.

Applicant also argues that Miner is adding a dielectric layer. Examiner respectfully disagrees. Miner's Figures 10(b) and 10(c) clearly show a single dielectric layer of silicon oxynitride whose oxygen content has been increased by a wet oxidation process; the nitrogen is simply redistributed. (See Miner's description of the Figures.) This is further emphasized by actual experimental SIMS data shown in Figures 9b and 9c which show a single continuous dielectric

film with both oxygen and nitrogen wherein the oxygen content has been increased by wet oxidation.

Applicant argues that Jeng does not teach Applicant's wet oxidation of the dielectric film at Applicant's time and temperature, but as indicated above each of the features is present either explicitly, implicitly, or inherently.

Applicant argues that Takemura does not teach Applicant's wet oxidation of the dielectric film at Applicant's time and temperature, but as indicated above each of the features is present either explicitly, implicitly, or inherently.

Regarding the "significant" diffusion of oxygen in Miner, in Jeng, and in Takemura. Because Applicant's disclosure provides absolutely no support for (1) absolutely no diffusion through the dielectric film or (2) a requisite or art understood standard for "does not *significantly* diffuse through the dielectric film," (emphasis added) beyond the resulting electrical/physical properties of the resulting dielectric film which include (1) the oxygen concentration is increased in the dielectric film, (2) the leakage current is reduced, and (3) the electrical properties of the film are stabilized, as presently claimed, Applicant's invention as presently claimed is indistinguishable from Miner and Jeng because each of Miner and Jeng's dielectric films show each of the three improvements in electrical/physical properties obtained by the same method as presently claimed. In Miner and Jeng, thin gate dielectric films are formed which are known to be electrically "leaky;" therefore, said dielectric films are, *inter alia*, wet oxidized in order to increase the oxygen content and thereby reduce the leakage current. The underlying layer (the silicon

substrate) remains unaffected by any "significant" diffusion of oxidizing species through the dielectric film. Although some oxygen diffuses through the dielectric layer in Miner and in Jeng, the amount cannot be considered "significant" by any standard thus far provided by Applicant since by such diffusion of the oxidizing species, the dielectric film resulting is improved in electrical properties which is the same objective and result as the desires in the instant invention. For at least these reasons, Applicant's arguments are moot.

Conclusion

18. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication from examiner should be directed to Erik Kielin whose telephone number is (703) 306-5980 and e-mail address is erik.kielin@uspto.gov. The examiner can normally be reached by telephone on Monday through Thursday 9:00 AM until 7:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Charles Bowers, can be reached at (703) 308-2417 or by e-mail at charles.bowers@uspto.gov. The fax phone number for the group is (703) 308-7722 or -7724.

EK

Chandra Chaudhari

Chandra Chaudhari
Primary Examiner

April 11, 2001